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QUANTITATIVE HIGH-FREQUENCY ACOUSTIC VOLUME SCATTERING FROM WELL-CHARACTERIZED BUBBLE CLOUDS

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LONG-TERM GOALS

Our long-range goal is to better understand the physics of acoustic scattering from naturally occurring bubble clouds, and to apply this knowledge to both the acoustic remote sensing of bubble populations in littoral and pelagic waters and the modeling and prediction of sonar performance for systems that operate in the near-surface environment. For example, within the near-surface environment, scattering from bubbles often dominates the reverberation for high-frequency O(10) kHz sonar systems [1,2].

OBJECTIVES

We are after a better understanding of: (1) single and multiple scattering from assemblages of bubbles, which ultimately determines the dynamic range of sonar systems response to bubbles, and (2) the effect viscous damping on bubble scattering which also influences system performance.

APPROACH

Our approach is based on: (1) generating a stable cloud of bubbles which is suspended in a polymer gel, (2) characterizing the bubble cloud's size distribution using optical techniques, and (3) making precise acoustic measurements of this cloud in a laboratory tank environment.

WORK COMPLETED

We have assembled a laboratory capability to generate artificial bubble clouds, characterize them in terms of their size distribution, and measure their acoustic backscattering properties. Preliminary experiments have been completed.

RESULTS

We have obtained some preliminary results on scattering from an assemblage of bubbles suspended in a medium consisting of water and polymer additives. The individual bubbles were separated by a characteristic distance **r**, such that **kr**, where **k** is acoustic wavenumber, did not exceed unity. Interestingly, our results seem to be in accord with with single scattering theory, though we must pin this down further and sort out multiple and coherent scattering effects [3-4].

IMPACT / APPLICATIONS

This research will contribute to a better understanding of how we interpret high-frequency acoustic volume scattering and attenuation from bubbles, particularly when applied to the case of high void fractions such as in ship wakes, or the shallow water surf zone.

TRANSITIONS

The results will be particularly useful to programs that address the influence of bubbles on naval systems operating near the sea surface, in the shallow water surf zone, or in vicinity of ship wakes.

RELATED PROJECTS

The work relates to the ONR program entitled "Influence of Bubbles on Naval Systems Operating in Shallow Water," and the March 1997 Scripps Pier Experiment, carried out under this program.

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